confirmatory of the malady under which they pretend to labour. We have met with instances in which persons pretended that they passed daily an amount of sabulous matter by the skin, or large masses of lime per urethram, or that they vomited insects, or voided small animals from the bowels, and carefully invented the circumstances which they supposed necessary to confirm their statements. In none of these cases have we been able to detect any other motive for the deception than a desire, perhaps, in the individuals to render themselves objects of wonder and attention. They neither solicited alms, nor ceased to follow their ordinary occupations, by which one or more of them supported their family quite comfortably. They were all very ignorant persons, of weak intellects, and extremely credulous. D. F. C.

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Art. XXII.—*Des Phénomènes de Contraction Musculaire observés chez des Individus qui sont Succombé à la suite du Cholera ou de la Fièvre Jaune.* Par George Henry Brandt, M. D. Thèse pour le Doctorat en Médecine, presentée et soutenue à la Faculté de Médecine de Paris, le 21 Août, 1855. 4to. pp. 46. Paris, 1855.

*On the Cause of the Muscular Contraction observed in the Bodies of those who die of Cholera and Yellow Fever.* By G. H. Brandt, M. D. A thesis presented to the Faculty of Medicine of Paris for the Degree of Doctor in Medicine.

The muscular movements which are often observed to occur after death in the bodies of those who have fallen victims to the cholera or yellow fever, would appear to be of a special character; they are unquestionably of a different character from those we observe at the moment of death, as well as from those which occasionally take place upon the occurrence of the cadaveric rigidity.

Although the occurrence of very marked muscular contractions of the limbs and even of the trunk, after death from cholera, is noticed by many of those who have described the disease during its wide epidemic spread since the year 1818, and the same phenomenon is stated to have been frequently observed after death from yellow fever, by writers of unquestionable authority, no one appears to have attempted to explain the cause of its occurrence, or even to examine into the particular circumstances under which it usually, or invariably takes place. It was not until the year 1849, that this phenomenon attracted any further attention, than the simple record of its not unfrequent occurrence, when Dr. Brown-Séquard first pointed out some of the leading circumstances which favour its manifestation, and subsequently attempted to explain its nature and cause. The observations made by this gentleman in 1854, in the large cholera hospital of the Island Maurice, of which he had the sole charge, have, he assures us, furnished him with additional proofs of the correctness of the views originally advanced by him five years previously.

According to Dr. B.-Séquard, the muscular movements referred to are always restricted to cases in which the individuals, of great physical vigour, have died within twenty-four hours from the commencement of the attack of cholera, and without having experienced paroxysms of cramp sufficiently violent or numerous to exhaust muscular irritability. The three circumstances, therefore, which, according to his observations, favour the production of muscular movements in the dead from cholera, are—

1. Strongly developed muscular force.
2. Short duration of the disease.
3. Absence of cramps, or, when present, slight or of short duration.

All these circumstances being united, the muscular movements after death are the most marked. Most frequently two only of them occur, namely, the first and second. It is seldom, indeed, that robust individuals are attacked with severe choleric symptoms, without the occurrence of violent cramp, but as in these cases death occurs early, the cramp, though severe, does not last sufficiently long to exhaust the muscular irritability. Occasionally the movements after death are observed in bodies with but moderately developed muscles, but only in cases in which the duration of the disease has been very short. The rapid occurrence of death is considered by Dr. B. S. as the circumstance most favourable to the occurrence of muscular contractions in the corpse. It is, he considers, essential that the muscles should retain after death, a considerable amount of irritability. This irritability, when not exhausted by long continued disease or poisoning, attended by violent and lingering convulsions, continues in the dead body much longer than is generally supposed. In two criminals, observed carefully by Dr. B. S., he observed it to be apparent in the one, thirteen, and in the other fourteen hours after decapitation. Under the same circumstances, we know that Nysten had in one instance known it to continue for twenty-six hours after death.

The duration of muscular irritability in the dead body being in inverse proportion to the extent to which it has been exhausted during life, it is to be concluded, therefore, that the muscular movements so often observed after death from cholera, will take place only in cases where the disease has been of short duration and has not had time to wear out the irritability of the muscular system.

"It may be objected," Dr. B. remarks, "to the position that there exists a direct relation between the muscular energy of the patient, and the duration of the movements which occur after death, that it is precisely in individuals of great bodily vigour, the disease is attended by cramps of extreme violence, which always exhaust muscular irritability. If it be objected, that as it is necessary for the existence of the movements after death, the muscles should still retain a large amount of their irritability, it would be impossible for these movements to be observed in the bodies of such as have had cramps, the answer is very easily given; in individuals of great bodily vigour, when the cramps have lasted for twenty-four hours, no movements occur after death; even when the cramps have existed for a few hours only, the movements observed after death are but slight in the muscles that had been the seat of cramp, while in the other muscles they may be very considerable."

The persistence of a large amount of irritability in the muscles being assumed as the condition necessary for the occurrence of the movements that take place in the bodies of those who have fallen victims to cholera; Dr. B. S. supposes that the exciting cause of these movements is the accumulation of carbonic acid in the blood and muscular tissue. He believes that, besides this, it is probable that there exists another agent which, during the epidemic prevalence of cholera, is generated in the blood and by its action on the spinal chord, or upon the muscles, produces the cramps characteristic of that disease, as well, perhaps, those also of which individuals, within the sphere of the epidemic influence, but not labouring under cholera, are often the subjects.

That carbonic acid is an excitant of the nerves and muscles, is shown by the sourish and pungent taste imparted to the tongue, when fluids strongly charged with carbonic acid gas are swallowed. Its action upon the nasal mucous membrane is evidenced by the well-known pungent sensation it excites in the nerves of this part when eructation occurs after drinking mineral water, beer, or champagne.

Wharton Jones has shown that in causing a current of carbonic gas to pass into the lungs of a frog, the bloodvessels contract, the blood globules become united to each other and adhere to the parietes of the vessels; upon arresting the current of gas the circulation resumes its normal condition; now these are precisely the phenomena that occur when the bloodvessels are subjected to galvanism, as the brothers Weber have shown.

Dr. B.-Séquard adapted to the trachea of an animal recently dead, of which the lungs had collapsed upon opening the thorax, a tube, the other extremity of which was connected with the body of a syringe. By retracting the piston of the latter the air contained in the lungs of the animal was removed, and then a quantity of carbonic acid, equal in amount to the air extracted, was slowly injected into the trachea. The flame of a candle being now brought opposite to the outer orifice of the tube was blown aside by the jet of gas coming from the lungs. The jet is produced by a contraction of the bronchi resulting from the contraction excited in them by the carbonic acid, as may be proved by substituting hydrogen or nitrogen gas for the carbonic acid, neither of which will excite the bronchi to contract, and consequently no jet from the lungs can be detected after they have been injected.

The heart of a frog removed for some minutes from the body, and contracting, in the atmospheric air, some 25 to 30 times in the minute, was placed in an atmosphere of carbonic acid. Almost immediately its pulsations increased to 40, 50, or even 60 in the minute.

From these facts it is evident that carbonic acid is an excitant of the nervous system and muscular tissue.

M. Herpin, of Metz, in a recent communication to the Academy of Sciences, thus describes his own experience of the effects of the carbonic acid: "The first impression that is experienced in plunging into a stratum of the gas, is a sensation of mild, agreeable warmth, similar to that produced by a thick clothing of fine wool or wadding; to this there succeeds a peculiar sense of pricking or formication, and, later, a sort of burning that may be compared to that produced by a sinapism when it commences to draw. Pains formerly experienced, especially those from old wounds, are revived; the skin becomes red; an abundant perspiration occurs, which exhibits an acid character on those portions of the surface that are exposed to the action of the gas. The sensation of heat and the perspiration continue during many hours after retiring from the bath. At first, the movements of the heart are but feebly accelerated, but after the immersion in the gas has continued some time, the action of the heart is increased; the pulse becomes full, quick and accelerated; the sensation of heat is more intense, and is attended with turgescence and redness of the skin, headache, oppression of the chest, etc."

Dr. Struve, on exposing his leg to the action of a stratum of carbonic acid gas, experienced, at first, a sense of formication and an agreeable warmth, which augmented until an abundant perspiration broke out over the limb.

M. Boussingault informs us that he experienced, in his own person, similar phenomena to those described by M. Herpin, on exposure to the carbonic acid which is largely disengaged from certain excavations in New Grenada.

"In all cases in which there is an increased quantity of carbonic acid in the blood, there takes place an excitation of the nervous system and of the muscles.

"*a.* In cases of asphyxia, general convulsions develop themselves, and it is evident that in these cases there is a coincidence between the augmentation in the blood of carbonic acid and the excitation of the nervous system and perhaps of the muscles. The convulsions in such cases have been vaguely attributed to a pretended desire for respiration. To show, however, that there is actually a direct excitation of the spinal chord, Dr. Brown-Séquard performed before the Biological Society the following experiment. He divided transversely the chord at the lumbar region, and then asphyxiated the animal. Convulsions ensued as well in the posterior as in the anterior limbs.

"*b.* Dr. Brown-Séquard has ascertained that the irritability augments in the muscles after the section of their nerves, and this augmentation continues to last for several weeks. If a mammiferous animal, in which the sciatic and crural nerves of one of the limbs had been divided ten days previously, be asphyxiated, we find that movements continue to occur in the paralyzed limb for some time after the cessation of general convulsions. This is an important fact, because it shows that in a part where the irritability is augmented, movements are produced, although there is the same condition of the exciting agent as in those parts of the body where the muscular irritability is in its normal state, but in which no movements take place.

"*c.* If we divide the phrenic nerves, the diaphragm ceases to contract rhythmically; upon asphyxiating the animal and destroying the spinal chord in the cervical and dorsal regions, the rhythmical movements of the diaphragm reappear, and only under the direct excitation of that muscle by the blood charged with carbonic acid.

"*d.* The movements which take place in the intestines when we open the abdomen after death, have been attributed to a pretended exciting action of the cold air. Dr. B.-Séquard has shown that the contraction referred to is the result of the excitation of the blood charged with carbonic acid. If, without opening the abdomen, we asphyxiate an animal, very violent movements take place throughout the intestines. If, on the other hand, we lay open freely the abdomen, the intestines will not be found to contract so long as the respiration is unrestrained; on asphyxiating it, however, almost immediately the intestines will commence to contract, and very soon their entire mass will become agitated. Similar experiments show that the same is true in respect to the bladder.

"*e.* If we asphyxiate a female guinea pig about to bring forth, it very often occurs that the uterus contracts and expels its contents. If we open the abdomen of a pregnant rabbit, on the 25th or 28th day of gestation, and expose fully the uterus to the action of the air, there will be found not to occur any contraction of the organ. If now the respiration of the animal be suspended, contractions will be seen to take place in the cornua of the uterus. The impediment to respiration being removed, these contractions will diminish or even cease. Asphyxia being again produced, very violent uterine contractions will again occur and sometimes expel one or more of the fœtuses.

"*f.* Relatively to the heart, the facts observed by Dr. B.-Séquard, and other physiologists, are more numerous, and perhaps still more decisive. When we divide the par vagum on both sides, the respiration diminishes and the quickness of the heart's pulsations increases. When we cut the great sympathetic on both sides, we find, also, that the pulsations of the heart augment in number, but, as R. A. Wagner has shown, to a less extent, and Dr. B.-Séquard has ascertained that in this case, as in the former, respiration is diminished.

"If any one will have the courage to arrest during one minute his respiration, he will find that during the last twenty seconds, the number of the heart's pulsations are more frequent than they were during the twenty seconds preceding the experiment.

"*g.* By injecting into different parts of the body blood charged with carbonic acid the contractile tissue of these parts are thrown into action. If, on the contrary, we inject red blood, or that charged with oxygen and containing little carbonic acid, contractions do not immediately take place, but, at the end of a certain time, when the blood injected has become changed into venous, the movements occur."

Thus having seen from the foregoing facts that the carbonic acid is an excitor agent of the nervous system and the muscles, it follows that, if we find very powerful excitation of these parts in all cases in which there is asphyxia, we have the right to attribute this to the augmentation of carbonic acid in the blood which then occurs.

The explanation proposed by Dr. B.-Séquard of the occurrence of muscular movements in the bodies of those who have died of cholera, is founded upon the two series of facts that we have just passed in review: 1st. The persistence of muscular irritability, in a very high degree, after death, in the cases in which these movements take place; and 2d. In such cases there is a considerable accumulation of carbonic acid in the blood, in other words, the blood has become excessively black, a condition, as has been shown, coexistent with exciting properties of a high grade. Hence, it is only in subjects of strongly developed muscular frames, that have been rapidly destroyed, in a state of asphyxia, that movements are observed after death.

It may be asked, why is it that in the cases referred to, movements occur in certain of the muscles and not in others? To this it is replied, that it is especially in those muscles which have not been, or only partially exhausted by the cramps by which the disease had been attended that the convulsions are observed. Besides, the bloodvessels of certain of the muscles which, during the lifetime of the patient, like those of the skin, were in a state of contraction, at the moment of death, dilate and allow the blood to flow into them, the excitation of which causes them to act.

In explanation of the fact that the muscles which are the seat of the post-mortem movements, cease their actions and resume them at a latter period, it is remarked that the excitor agents of the muscles of animal life are capable of acting, also, upon the muscular fibres of the bloodvessels. Hence, when the muscles of animal life are thrown into action by the carbonic acid, or other exciting agent existing in the blood of those attacked with cholera, their bloodvessels are excited to contraction at the same time, and the blood is, in consequence, expelled from them. Now as this contraction cannot continue for any time, when the cause of excitation is in this manner removed from them, they relax and the blood returns into them again, when, of course, the excitation is renewed.

Why is it that muscular contractions do not occur after death in individuals that have fallen victims to other diseases than cholera and yellow fever?

"We must exclude from the cases in which these contractions are liable to take place all those in which the muscular irritability, either from the long duration of disease, or any other cause, has been greatly diminished before death. It is only in cases in which muscular irritability still persists to a considerable extent at the moment of dissolution that muscular movements present themselves in the dead body. These cases are those in which life has been extinguished by decapitation, submersion, strangulation, certain poisons, etc. But, in all these the second of the two conditions essential for the production of post-mortem muscular movements is wanting, namely, a sufficient quantity of the excitant agent in the blood for the production of those movements. Besides, as has been already remarked, Dr. B.-Séquard considers it probable that there exists in the blood of those affected with cholera or yellow fever a special excitant agent, which is, perhaps, the very poison by which these diseases are produced, or, at least, which is generated by the action of the poison upon the system. It may, however, be replied, that if there exists a special exciting agent in the diseases indicated, it is useless to invoke the action of carbonic acid in the blood, especially as this acid exists in the blood of individuals destroyed by asphyxia, who, also, possess, often, very great muscular irritability, and in whom, nevertheless, no muscular movements occur after death. This objection is easily refuted. In the first place, there is a larger amount of carbonic acid accumulated in the blood of such as fall victims to cholera or yellow fever, than in those destroyed by asphyxia, and the muscular irritability may be equal in both cases; consequently the movements are the result in the one case of an adequate amount of the excitant agent, their absence, in the other, is the result of a deficient amount of this agent. Again, even admitting that no such difference in the amount of carbonic acid exists in the two classes of cases, it merely requires the addition of another exciting cause in the instances in which the post-mortem movements occur, one, namely, special to the diseases after which they are ordinarily observed. Finally, even though it should be shown that this special exciting agent is alone sufficient to give rise to the muscular contractions that occur after death from cholera and yellow fever, it may not be the less true that the carbonic acid accumulated in the blood plays a part in the production of these contractions, inasmuch as it has been shown to be an excitor of the muscles."

We have presented a tolerably full exposition of the views of Dr. B.-Séquard in relation to the cause of the movements observed in the bodies of those who have fallen victims to cholera and yellow fever, as detailed in the thesis of Dr. Brandt. They are ingenious and plausible, while the facts and arguments by which they are supported and illustrated are replete with interest. The position assumed by Dr. B.-Séquard, that, in the cases in which the post-mortem movements are observed, there is an increased irritability of the muscles, Dr. Brandt pronounces to be certainly not sustainable, and we think that in this he is correct, for it is extremely improbable that an increased irritability of the muscles can occur after diseases in which the normal condition of the blood is so greatly changed, and where especially its amount of oxygen is so notably diminished. D. F. C.